Supplementary Information

A Hierarchical Hollow Pt@H-UiO-66-NH_2/CdS Ternary Catalyst for Efficient Visible Light Prompted Photocatalysis

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1. Synthesis of contrast catalysts

1.1 Synthesis of Pt NPs

The Pt NPs were synthesized according to the reported method with some modifications.[S1] Typically, 222 mg poly(vinylpyrrolidone) (PVP, MW = 55,000) was dissolved in 20 mL of ethylene glycol in a round-bottomed flask. Then 50.75 mg $H_2PtCl_6 \cdot 6H_2O$ was added and dissolved thoroughly. The solution was heated to 180 °C and maintained at this temperature for 10 min, then the as-synthesized Pt NPs were precipitated by acetone and collected by centrifugation at 9,000 rpm for 5 minutes. The sample was washed with n-hexane for three times to remove excess free PVP and was finally dissolved in 16 mL of deionized water for further use.

1.2 Synthesis of H-UiO-66-NH_2/CdS and UiO-66-NH_2/CdS

For comparison purposes, H-UiO-66-NH_2/CdS was synthesized in the same way as Pt@H-UiO-66-NH_2/CdS except that Pt@H-UiO-66-NH_2 was replaced by H-UiO-66-NH_2. UiO-66-NH_2/CdS was synthesized in the same way as Pt@H-UiO-66-NH_2/CdS except that Pt@H-UiO-66-NH_2 was replaced by UiO-66-NH_2.

2. Figures and tables

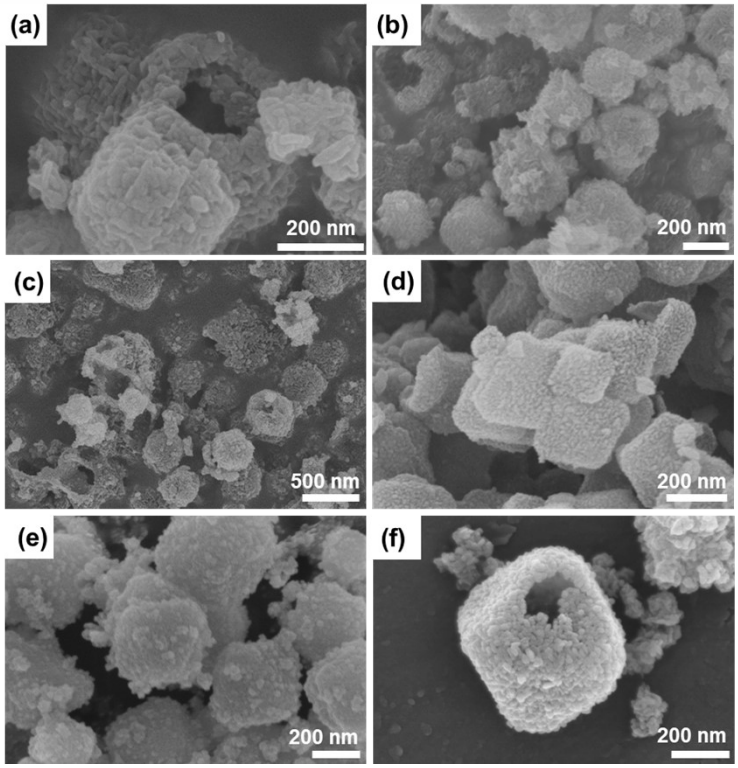

Fig. S1 SEM micrographs of (a) H-UiO-66-NH_2, (b) Pt@H-UiO-66-NH_2, (c) H-UiO-66-NH_2/CdS, (d) UiO-66-NH_2/CdS, (e) Pt@UiO-66-NH_2/CdS and (f) Pt@H-UiO-66-NH_2/CdS.

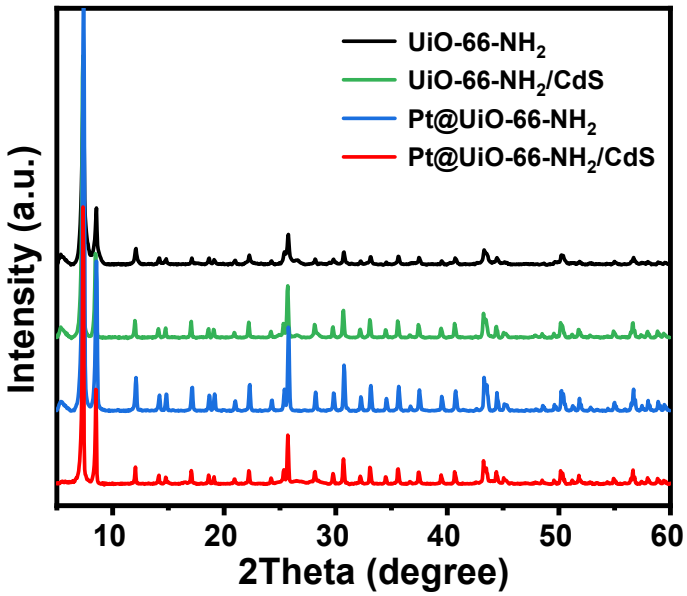

Fig. S2 Powder XRD patterns of UiO-66-NH_2, UiO-66-NH_2/CdS, Pt@UiO-66-NH_2 and Pt@H- UiO-66-NH_2/CdS.

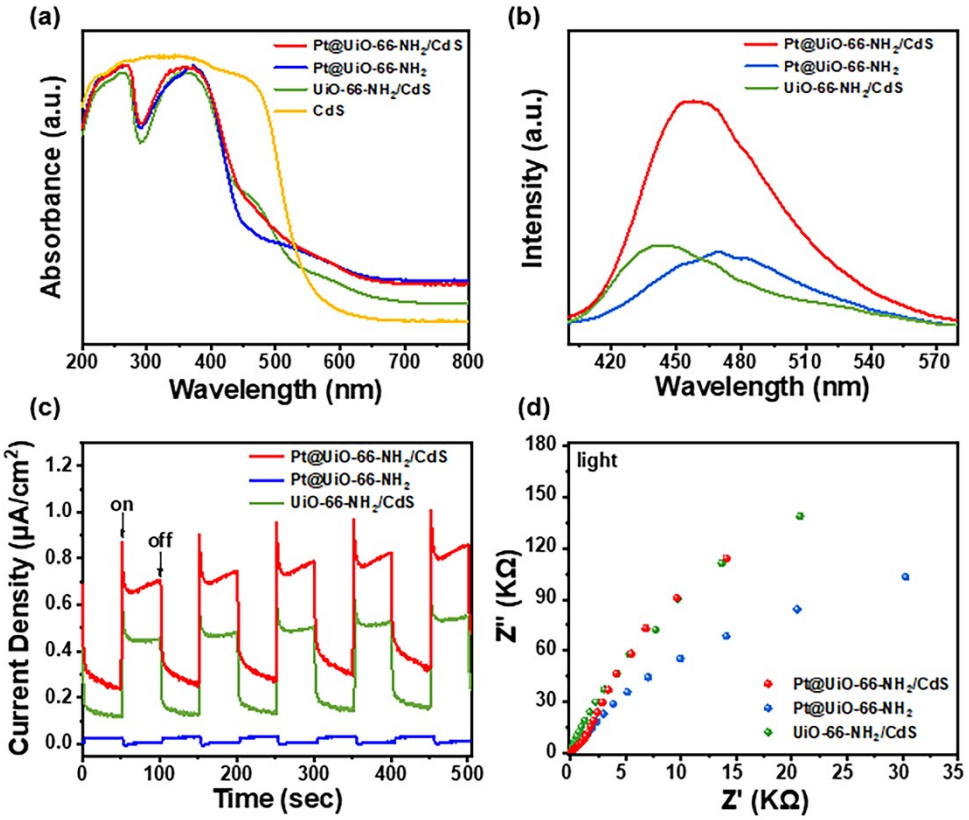

Fig. S3 (a) UV–vis absorption spectra of Pt@UiO-66-NH_2/CdS, Pt@UiO-66-NH_2, UiO-66-NH_2/ CdS and CdS; (b) photoluminescence spectra, (c) transient photocurrent response and (d) EIS Nyquist plots at light of Pt@UiO-66-NH_2/CdS, Pt@UiO-66-NH_2 and UiO-66-NH_2/CdS.

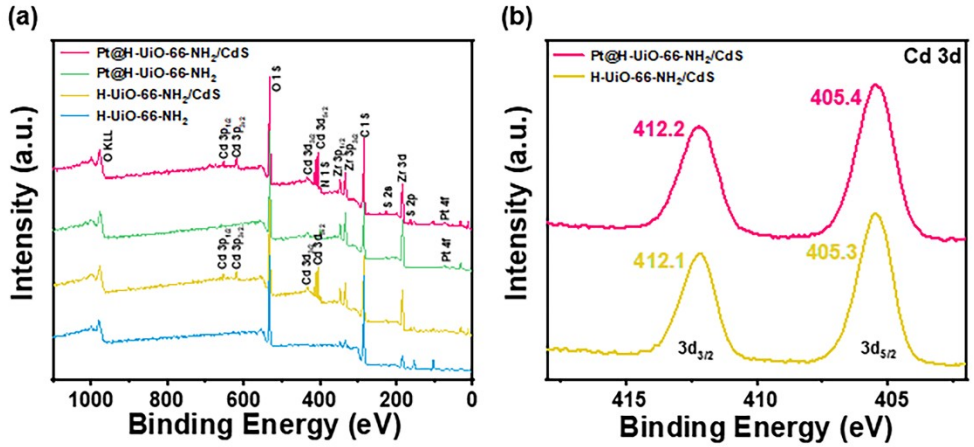

Fig. S4 (a) XPS survey spectrum H-UiO-66-NH_2, H-UiO-66-NH_2/CdS, Pt@H-UiO-66-NH_2 and Pt@H-UiO-66-NH_2/CdS; high resolution XPS survey spectrum of (b) Cd 3d.

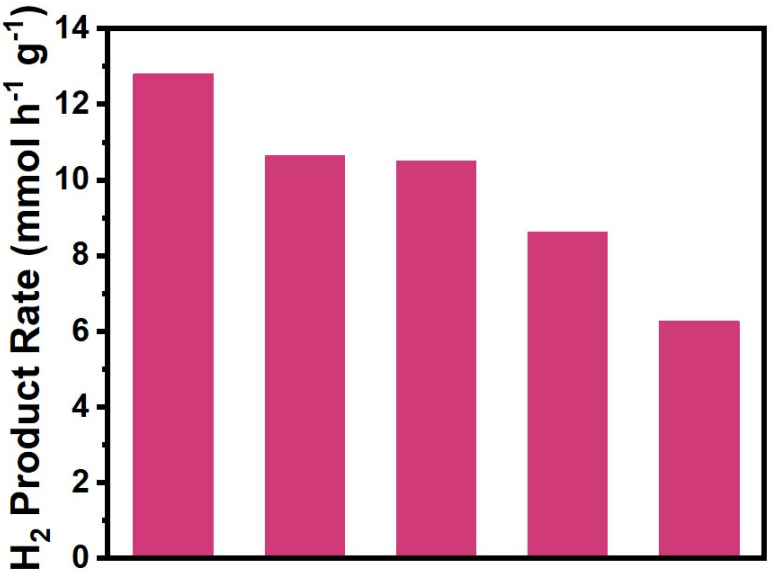

Fig. S5 five continuous cycles of photocatalytic H_2 production of Pt@H-UiO-66-NH_2 /CdS.

Five cycles had been done, showing as the Fig. S5. In some systems, a certain amount of sacrificial agent is added during each cycle to ensure the photostability. But our system is a closed test environment. We didn't add extra sacrificial agent after each cycle, so there is somewhat decline of the hydrogen evolution after the third cycle.

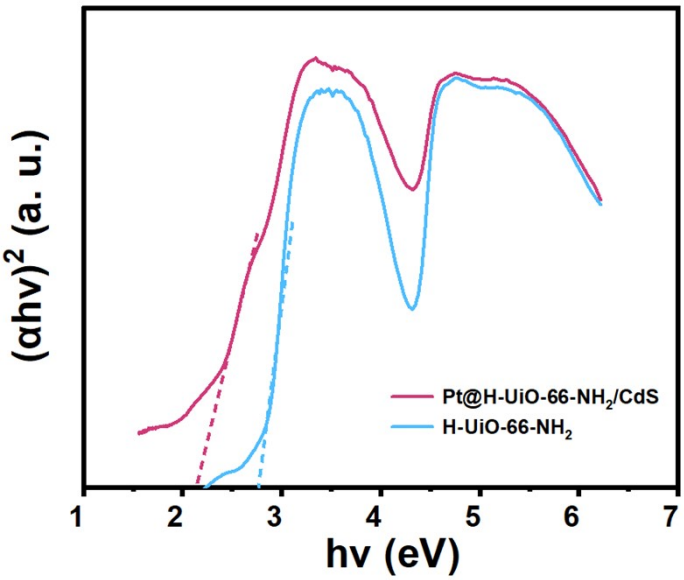

Fig. S6 Curves of Kubelka-Munk function as the vertical axis and plotted against the photon energy.

Table S1 BET surface area of the materials.

entry	catalyst	BET surface area (m^2/g)
1	UiO-66-NH_2	619
2	H-UiO-66-NH_2	471
3	Pt@H-UiO-66-NH_2/CdS	351

Table S2 Photocatalytic degradation rate constant of MB over the varied MOF-base catalysts.

Catalyst	1	2	3	Average Value
Pt@H-UiO-66-NH_2	2.28	2.07	2.02	2.12
UiO-66-NH_2/CdS	4.72	4.17	3.93	4.27
H-UiO-66-NH_2/CdS	5.51	5.49	4.94	5.31
Pt@UiO-66-NH_2/CdS	6.68	6.11	6.08	6.29
Pt@H-UiO-66-NH_2/CdS	10.89	10.25	8.5	9.88

Table S2 have listed the *Rate Constant* × 10^{-3} and the corresponding *Average value* from three experiments for the varied MOF-base catalysts.

Table S3 Comparison of the other MOF-based photocatalysts reported in literatures.

Photocatalyst	Light	Sacrificial agent	H_2 production rate (μmol h^{-1} g^{-1})	Ref.
Pt@H-UiO-66-NH_2/CdS	Visible light	Na_2S/Na_2SO_3	12810	This work
$Cd_{0.2}Zn_{0.8}S$@UiO-66-NH_2	> 420 nm	Na_2S/Na_2SO_3	5846	S2
CdS/UiO-66	> 380 nm	Lactic acid	1725	S3
Pt@MIL-125/Au	> 380 nm	TEOA	1743	S4
MoS_2@Cd-MOF	Visible light	Na_2S/Na_2SO_3	5587	S5
CdS@UiO-66@Pt	> 420 nm	TEOA	660.5	S6
Au@NH_2-UiO-66/CdS	> 420 nm	Lactic acid	664.9	S7
NH_2-UiO-66/CdS	> 420 nm	Lactic acid acetonitrile	16500	S8
BW/UiO-66/CdS	Visible light	Lactic acid	10185	S9

Reference:

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